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Discussion

Dr Richard J. Shemin *(Los Angeles, Calif).* I, too, want to thank the Association for the opportunity to comment on this really detailed and excellent study and presentation. The authors were able to provide me with a detailed copy of the manuscript so I have more information than was presented today.

The fact that there is a price to pay for complications is well known to this surgical community, but this study really met the goal of quantifying the cost in dollars, days, and deaths, as well as the postdischarge resource use after an isolated mitral valve surgery. As the discussion clearly stated, this comes from an administrative data set, the Nationwide Inpatient Sample (NIS). This sample is only 20% of nonfederal hospitals in 37 states and the use of ICD-9 codes, as has been stated, has major limitations and clearly does not allow a robust evaluation for risk adjustment and other analyses that we are used to from the Society of Thoracic Surgeons (STS) data base. The overall sample in this study was taken from 2 years—2006 and 2007—more than 16,788 patients. I was somewhat surprised to find that 10,000-plus patients actually had concomitant procedures, leaving them with isolated mitral valve surgery in 6297, and then I was also surprised to find 50% of them actually had mitral valve repairs as opposed to replacement. I am not sure we would have predicted that was the case. The inpatient hospital mortality was actually quite good, 4% and 2% in elective cases, and 82% of the patients did not have any of complications that were studied in this particular study. The complication rates also of interest did not differ between repair and tissue replacement or mechanical replacement and a single complication clearly escalated the outcomes and the end points such as mortality, length of stay, and cost, and the need for increased resources. Very interesting was the exponential increase in cost associated with multiple complications. I was really surprised to find that pneumonia and sepsis were your most frequent complications. I suspect this was because of the study design and the choice of complications that you included in the study. These potentially preventable complications can increase the cost of hospitalization by more than $30,000. Cardiac tamponade, which was the most costly complication in the study increasing the median cost by $57,000, only occurred in 0.1% of the patients. Therefore, I assume the ICD-9 codes were not capturing patients going back to the operating room for bleeding, the use of blood utilization, and as you mentioned the lack of studying atrial fibrillation, which is very frequent, or sternal wound infection, which is infrequent but very costly, is clearly a limitation. Therefore, I think this study only looks at the tip of the iceberg as far as the true cost of complications after isolated mitral valve surgery. Therefore, the study challenges us to really improve on the strategies that we need to incorporate to reduce the costs of taking care of our patients. Therefore, I have 4 questions for you.

First, do you have any data on the impact of surgical volume at these various hospitals, whether it be total cardiac surgery volume or mitral valve surgery volume, on the frequency of the complications, or the cost?

Dr Iribarne. Thank you, Dr Shemin, for your careful and thoughtful review of our manuscript.

First, regarding the quality of the data, NIS has a number of attractive features. It is accessible, inexpensive, and easy to use. Moreover, it contains information on the clinical and economic data of the patient, as well as information on the institution. Finally, although crude, the use of ICD-9 codes to extract clinical information from administrative datasets is a proven and increasingly applied research approach.

However, we agree that this data has all of the limitations associated with the use of large claims datasets. For example, as you

point out, the incidence of tamponade was clearly underestimated by this analysis. Further, sepsis was likely overcoded and more likely overlaps with other types of cardiovascular compromise and pressor dependence.

Our group is exploring the use of other large data sources to pursue similar questions to those proposed here. These might include the Centers for Medicare and Medicaid Services (CMS), Thompson-Reuters' Marketscan data, the University Health System Consortium (UHSC) data, and various statewide quality initiatives. Finally, in the future, STS data may be linked to costing data, and this may provide a powerful tool for pursuing these cost questions.

With regard to the first question, it is possible to capture institutional volume data in the NIS. Other groups have done this and, in fact, we have explored questions using this data. However, for this analysis, we did not explore the relationship between volume cost. I think that this is, however, an important but complex group of questions that are worth exploring.

Dr Shemin. Clearly, if one does find that to be the case as we find in many other areas of surgery, you can incorporate and find best practices that can be taught to others as we look for ways to find solutions.

The second question has to do with whether or not there is anything in your data set that will allow you to predict the 15% of patients who would have the complications that you showed us so that strategies can be targeted to those patients and specific complications and not have a very expensive protocol to try to incorporate everyone?

Dr Iribarne. Defining the relationship between preoperative comorbidities and outcomes, including complications and cost, is possible with this data. We have previously explored this in other populations, including a single institution's series of ventricular assist device patients. We are also interested in exploring the usefulness of various severity or comorbid illness tools, including the Deyo modification to the Charlston index, the Elixhauser index, and the 3M APR-DRG, to pursue other questions related to volume-outcome relationships across levels of patient risk and comparing disease-specific therapeutic options across various patient risk strata.

Dr Shemin. And I have a methodologic question. When you went ahead and looked at the 20% costs and then you looked at the total costs by increasing it by a factor of 5, is that technically correct? As I understand it, there are actually correction values that come with the nationwide sample that allow you to look at the total cohort and not necessarily do some arithmetic by increasing 20% to 100% by just multiplying by 5.

Dr Iribarne. You are correct. The NIS assigns a correction factor to each patient and institution. The cost estimates that we presented were ranges based on bootstrapped estimates. Therefore, the estimates are unlikely to differ significantly. Nevertheless, per your suggestion, the final version of the manuscript uses an NIS-provided correction factor to calculate this estimate.

Dr Shemin. The final question is, now that you have these data, what types of things do you think we need to do to reduce this complication rate and better treat these patients?

Dr Iribarne. Thank you for your question. This analysis alone does nothing to improve outcomes or decrease costs. However, we hope that it highlights opportunities for improving outcomes, decreasing costs, and therefore offering greater value in health care. As you suggested earlier, as a health care community, we need to be more aggressive by identifying best practices. We applaud these efforts, particularly of surgeon-driven statewide efforts to improve quality, including those in Northern New England, Virginia, and Washington State. We hope that other regions adopt similar methods. Further we see an opportunity for similar continuous quality improvement efforts to be based on specific therapies, such as transplantation, ventricular assist devices, and valvular therapies.